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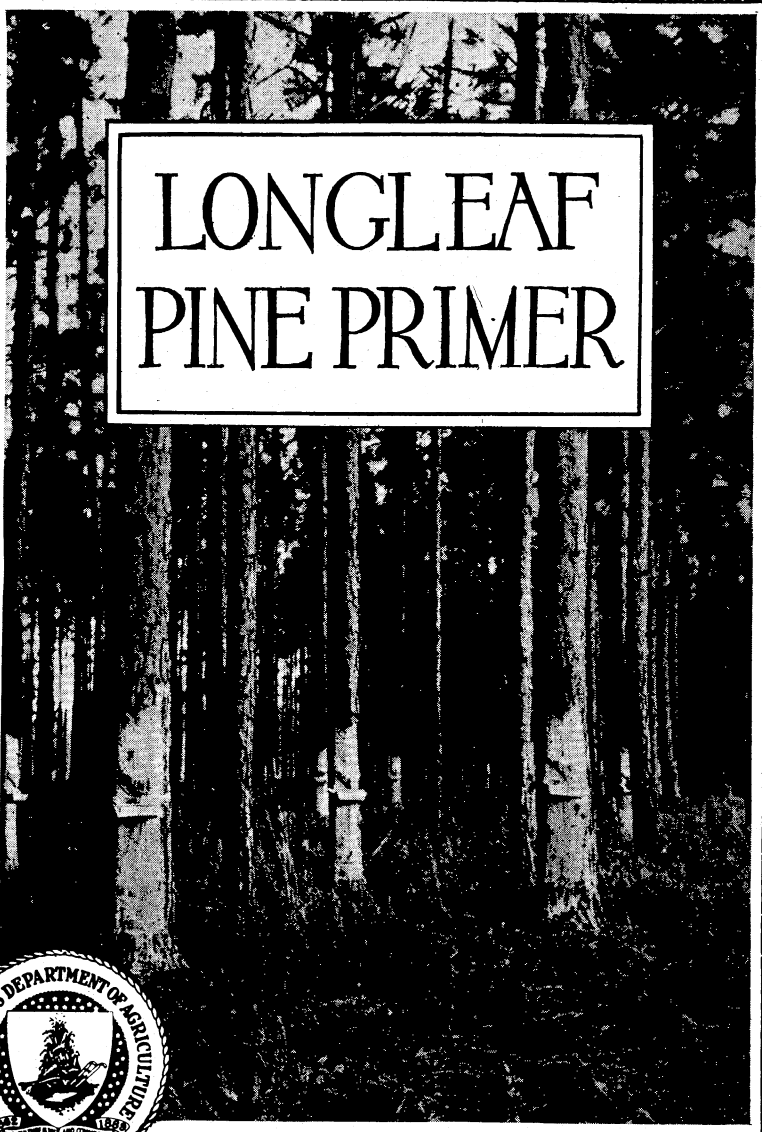

LONGLEAF PINE PRIMER

PINE TREES can now be profitably grown as a soil crop. A large area of land in the coastal-plain region of the South is better adapted for growing longleaf pine than for any other use. This area consists of portions of farms as well as large cut-over tracts in the hands of lumbermen.

Longleaf pine possesses several characteristics which makes it rank high among the four important commercial pines of the South. It has a large capacity to thrive in very poor sandy soils, to withstand ordinary fires with relatively small injury, and to produce a dual crop of turpentine and high-grade timber.

The purpose of this bulletin is to offer suggestions to farmers and other timberland owners for managing their stands of longleaf pines and for planting small longleaf seedlings to be grown as a crop for profit.

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LONGLEAF PINE PRIMER

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CONTENTS

GROWING LONGLEAF PINE AS A CROP

THE TIME has come when pine timber is so scarce and high priced that trees can be profitably grown as a crop. Some land on every farm and large areas of cut-over land in the South are better fitted for timber growing and will make more clear profit in timber than in any other use.

Longleaf pine grows a little slower on the average than shortleaf, loblolly, and slash pines, but possesses certain characteristics which make it rank along with these three other important southern pines as a tree for profitable investment in the growing of timber. It is of particular value because of its capacity to grow in the poorest and deepest sandy types of lands and thereby convert them from an economic liability into an asset.

The aim of this publication is to offer suggestions that may be helpful in the growing of longleaf pine for profit.

Why is longleaf pine a profitable tree to grow as a crop?

Longleaf pine possesses three qualities which make it a profitable forest tree for growing as a crop in the South: (1) It produces a dual crop of timber and turpentine. (2) It grows on the driest and deepest sandy soils and on wet lands. (3) It withstands to an uncommon degree the injurious effects of fire.

The timber of longleaf pine ranks high in quality. The crude turpentine, however, from second-growth longleaf pine often brings in as much money to the owner as the timber does after it has been worked for turpentine.

In the very deep sandy soils, which make up large areas in the South, longleaf pine excels all others in its ability to grow. (Fig. 1.) This is partly because of its very long, stout taproot. There are other lands of relatively low value which will not be needed for agriculture for a half century which can be put to profitable use by growing crops of longleaf pine.

Though other kinds of southern pines make a faster growth during the first few years than does longleaf, it is not difficult to propagate and

is easy to plant when one season old. Perhaps few people realize that, after the first four or five years, young longleaf pine when protected from fire and razorback hogs grows at a comparatively rapid rate.

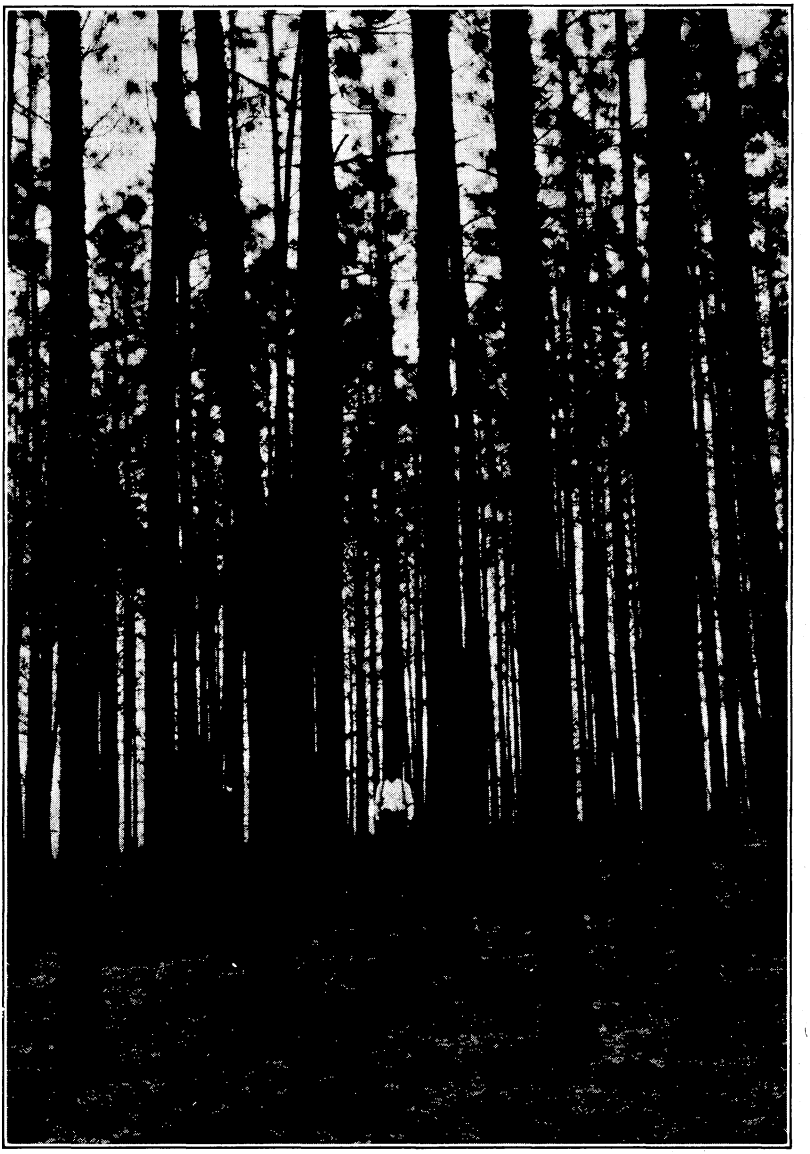

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FIGURE. 1.—A well-tended longleaf pine stand. The owner knows that timber can be made a paying part of farming. The crowded trees have been cut during the growth of the stand, which is now about 40 years old.

Money returns from growing longleaf pine are comparatively sure. Earlier returns can usually be realized from the faster growing shortleaf, loblolly, and slash pines, but none of them succeed so well on

large areas in the South, and all are much more susceptible than longleaf to serious set-backs or killing by fires in early life. This natural resistance to fire alone entitles longleaf pine to careful consideration as an investment in growing timber on a commercial scale.

Where can longleaf be profitably grown?

Longleaf may (as a general rule) be expected to grow anywhere within its natural or botanical range, as shown in Figure 2. The areas indicated as the region of commercial importance contain more longleaf timber or are a little better adapted to its production.

Where longleaf pine occurs already on the land, either as trees bearing seeds or a young growth, it will pay the owner to protect the timber and grow it as a crop. There are always small patches of land scattered here and there that become needed for various other uses; but, generally speaking, no more stump land in the South is needed for agriculture.

On the other hand, there are large areas of denuded land. If these are ever used for growing timber, they will have to be artificially reforested. Even starting with the bare soil, the growing of longleaf pine will undoubtedly pay.

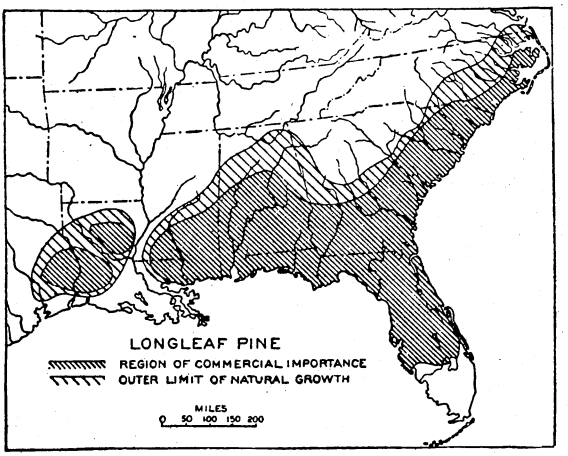

FIGURE 2.—The region within which longleaf pine is natural, and the more restricted portion where it is of commercial importance

In the better soils it seems likely that loblolly or slash pines will generally give larger returns, chiefly because of their more rapid growth. Anyone familiar with the southern coastal plain will realize the great diversity of soil types which prevail in any given locality. Longleaf appears to thrive the best of any of the important southern pines in the sand hills extending from southern North Carolina into eastern Alabama and in the deep sandy lands of Florida. As soon as the people come generally to recognize the destructiveness of fires, it is certain that this tree will naturally come back over the coastal plain and be regarded as a money crop to rehabilitate the land.

THE TREE

How may longleaf pine be recognized?

Longleaf pine is undoubtedly the most widely known or recognized of all the southern pines. The leaves are mostly from 8 to 15 inches in length and always grow three in a bundle or sheath. The bur varies mostly from 8 to 12 inches in length. (Fig. 3.) The bark is made up of broad, smooth scales. The stem of the tree is straight and averages a little smaller in diameter at any given age than that of the short-leaf, loblolly, or slash pines.

In another respect longleaf differs from all the other pines, for its taproot just below the surface is nearly as large as the tree trunk, tapering gradually and sometimes extending to depths of 10 to 15 feet. This makes the tree relatively windfirm and able to live in deep, dry soils.

The wood of longleaf is harder, stronger, and heavier than that of all the southern pines except slash pine, a close relative. The successive dense rings of "summer" wood are relatively wide and sharply divided from the intermediate light-colored rings of softer "spring" wood.

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FIGURE 3.—Pine trees come from seed, or mast, borne in the burs. Good seed-bearing trees are necessary for the satisfactory reforesting of land after cutting

CAN LONGLEAF PINE COME BACK?

How does longleaf pine reproduce itself?

By seed which is borne in the burs or cones. Young pines never spring up from the roots, as do many hardwood trees.

Does longleaf pine ever come back after logging?

Yes, if seed trees are left and the land protected from fire and razorback hogs. There is no mystery connected with the coming in of young growth following cutting. The natural reforestation of any kind of pine depends upon whether nature is given a chance. (Figs. 4 and 5.) To get a crop of young longleaf pines, sufficient trees must be left in logging to provide seed, and the land must be adequately protected to allow the young pines to grow.

Often scrub oaks are observed to follow longleaf pine, especially on dry, sandy ridges. This is largely because not enough seed-bearing trees were left and fires have been allowed to run every year or two. Any young pines that came in were killed or badly injured, while the small oaks (already present at the time of cutting) sprouted vigorously. The abuse of the timberland by man accounts for the absence of another longleaf crop.

How often is mast, or seed, produced?

A heavy crop of mast, or seed, of longleaf pine usually occurs at intervals of about every seven years and partial crops between times.

What happens to the mast or seed?

The seeds are larger and do not fly so far as do the seeds of the other important species of southern pines. They are rich and pal-

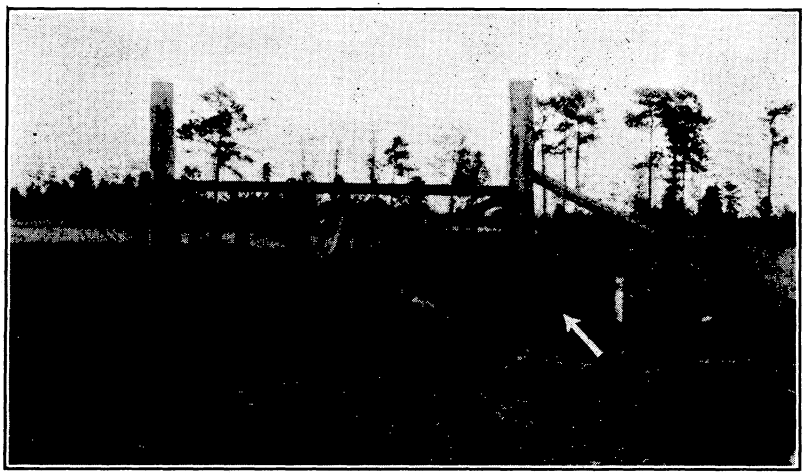

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FIGURE 4.—View at the beginning of protection. The land had lain idle for 15 years after logging and was burned over nearly every year. A few fire-stunted longleaf pines were on the land; a few seed trees are near by

atable, and therefore eagerly sought and consumed by mice, birds, squirrels, hogs, and other animals. No plump seeds could be found

F-194189

FIGURE 5.—View of the same land after 12 years of protection from fire and razorback hogs. Growth is more than a cord an acre yearly. The white arrow points to the same tree, which began to shoot upward as soon as the burning ceased. Coastal plain of South Carolina

near one group of scattered longleaf trees four weeks after the shedding of a heavy seed crop.

Before the longleaf pine forests were so heavily cut as now, many cull trees were left, and abundant seed was available for good reseed-

ing of the land. If fires were kept out, especially for three to five years afterwards, splendid stands of young growth usually resulted. On old cut-over lands, perhaps as many as five to seven dense covers of young seedling have resulted since cutting, only to be successively wiped out by repeated burnings.

When do the seeds of longleaf pine sprout?

Over much of its natural range the seeds of longleaf germinate in the fall, during the few weeks after they leave the tree. This is especially true in fall seasons of plentiful rains. In the more northerly portions of its range, germination is probably less likely to occur until the following spring. The same is true during long dry spells

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FIGURE 6.—Trees which have plenty of sunlight and moisture in the soil grow more vigorously than those in overcrowded stands

in the fall. Under such circumstances many of the seeds are eaten, and scant forest regeneration is established.

GROWTH

How fast does longleaf pine grow?

Longleaf pine grows at a moderately rapid rate. It grows much faster in some soils than in others.

One reason for this moderate rate of growth is that the tree is found extensively in the sandy and poorer types of soil. The loamy soil belts have become more largely improved for agriculture. In the better classes of soils, after the first four years, longleaf pine grows about as rapidly as loblolly, shortleaf or slash pines. It has the power of persisting for many years in its good rate of growth, whereas the other trees fall off rather rapidly after the first 15 to 30 years.

During the first three to five years the young longleaf makes root growth chiefly. It then begins to grow a stem. The upward growth

continues at the rate of 1 to 3 feet a year, depending upon the kind of soil and moisture conditions. The degree of protection from fire affects the growth in height as well as in diameter of the stem. To reach 5 feet in height may require five to seven years.

The number of trees on any given area has much to do with the rate of growth, as the roots of each tree are competing with those of its neighbors for the soil moisture.

In growing pine trees, whether for timber or turpentine, the landowner should be much concerned with the density of the stand, or the number of trees per acre. Trees grown singly are often bushy-topped and therefore less desirable for timber, but yield more gum than close-grown small-topped trees. It will readily be seen that a tree will grow faster in the open than in a close stand, or tree community. (Fig. 6.) On the other hand, too few trees per acre mean reduced timber production. There is an ideal, or best, tree density for each tree age and each kind of land. A woods of the right density will give the largest yield and returns per acre. This is a midway point between very open spacing and overcrowding where the branches meet. The rate of tree growth shown in Table 1 is based on measurements taken in well-stocked stands of longleaf pines. Three grades of soil or situations are shown and the resulting range in the amount of growth at any age can be found by comparing the values for the different qualities of land.[1] For example, at 20 years of age the average height of the trees is about 46 feet, on the good land, 36 feet on average-quality land, and 26 feet on the poor land.

To figure the growth in height or diameter during any period, find the difference as shown at two successive ages. These values, it should be noted, are for unmanaged stands that have been burned over repeatedly. If unburned and tended stands had been available, the sizes of the trees would undoubtedly have been from one-half to three-quarters larger at the same ages. The same will undoubtedly be true of longleaf pine grown under good practice as a crop.

TABLE 1.—*Average height and diameter of longleaf pines at various ages, grown in well-set or thick stands on different qualities of land, and the number of trees per acre*

Age of trees in the stand	Height of tree on—			Diameter of tree [a] (breast high) on—			Trees 7 inches and over in diameter on an acre on—		
	Good land	Average land	Poor land	Good land	Average land	Poor land	Good land	Average land	Poor land
	Feet	*Feet*	*Feet*	*Inches*	*Inches*	*Inches*	*Number*	*Number*	*Number*
15 years	33	26	18	4.6	3.8	3.0	13	3	--------
20 years	46	36	26	6.1	5.1	3.9	110	35	--------
25 years	57	45	32	7.1	6.0	4.7	211	112	--------
30 years	66	52	37	8.0	6.8	5.4	255	170	35
35 years	74	57	41	8.9	7.6	5.9	266	208	61
40 years	80	62	45	9.6	8.2	6.4	265	235	100
45 years	85	66	47	10.3	8.8	6.9	261	249	136
50 years	90	70	50	11.0	9.3	7.3	255	255	160
55 years	94	74	53	11.5	9.8	7.7	242	253	175
60 years	98	77	55	12.0	10.2	8.0	230	245	185
65 years	102	79	57	12.5	10.6	8.4	222	240	192
70 years	105	82	58	12.9	11.0	8.7	215	235	195

[a] Diameters are measured at breast height, or 4½ feet above the ground.

[1] The tables of growth and yield of trees and stands are furnished by the Southern Forest Experiment Station of the Forest Service, with headquarters at New Orleans, La.

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How much does burning affect the growth of longleaf pine?

If fire does not kill the tree it seriously affects its vigor and growth. There are people who honestly believe that fire has little injurious effect upon pines. This is because they see many of the trees sprout out following a fire, and have never made any close observations on burned and unburned lands.

Have we any definite information regarding the effect of burnings on growth?

During the fall of 1913 a heavy seed crop of longleaf pine fell and germinated. Since then, the Forest Service has kept a careful record of the growth of longleaf pines on a protected, unburned tract and on an adjacent tract which has been burned over yearly. The two were alike in area (one-fourth acre each) and similar in respect to soil, to stand of young trees, and to complete protection from razorback hogs.

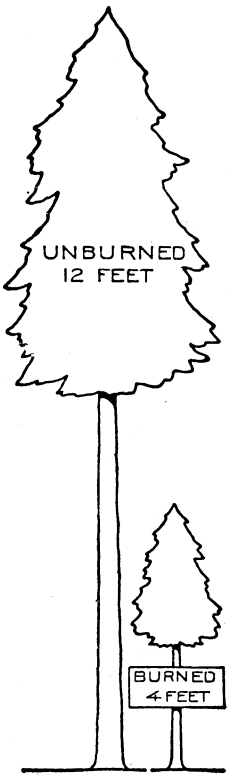

FIGURE 7.—Growth in height of 10-year old longleaf pine trees under protection and under yearly burning. (Measured in experiment plots in La Salle Parish, La.)

The results are convincing evidence that trees suffer from fire. At 10 years of age, the trees on the unburned tract (fig. 7) averaged 12 feet in height, while those on the adjacent tract, burned over yearly, were only a little over 4 feet. Burning greatly checks growth in height. In the 10 years, the accumulated growth in diameter of the longleaf pines on the unburned tract of one-fourth acre was equal to that of a single tree whose cross section measures 19 square feet, while the trees on the tract burned over yearly had made a growth of only 1¾ square feet. (Fig. 8.) If the unburned area had pooled all its effort, it would have grown a tree nearly 6 feet in diameter while the burned tract grew one of only 18 inches. During the last year, the total growth for that one year on the protected tract was 6½ square feet, as compared with 1 square foot of increase on the burned-over tract. Protection from fire is essential in growing pines for profit.

TIMBER PRODUCTION

How much longleaf timber will an acre produce?

The owner or the prospective buyer of timberland should know its capacity for producing timber Fortunately, the amount of longleaf pine timber that can be grown per acre can be predicted because of studies which have been made of many well-set stands. The values shown in Tables 2 and 3 are for stands that, however, have been burned over frequently. It is regretted that the rate of timber production is not known for protected stands, as it would unquestionably be considerably larger.

The amount of timber per acre at various ages is given in terms of crossties, cords of firewood or pulp wood, and board feet of saw timber. For example, 1 acre of longleaf pine, 40 years old, on medium-grade

soil, may be expected to yield about 245 crossties, or 39 cords of unpeeled wood, or 31 cords of peeled wood, or 10,000 board feet of saw timber.

TABLE 2.—*Approximate estimate of crossties and cordwood (pulp wood or fuel wood) produced per acre by well-stocked, even-aged stands of longleaf pine at different ages*

Age of stand	Crossties (No. 3, 6 by 8 inches by 8 feet) produced on —			Production of cordwood of the kind stated on—					
				Wood with bark (fuel wood, etc.)			Peeled wood (pulp wood, etc.)		
	Good land	Average land	Poor land	Good land	Average land	Poor land	Good land	Average land	Poor land
	Number	*Number*	*Number*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*
20 years				26	14	4	20	10	3
30 years	230	30		43	28	11	35	21	8
40 years	440	245	50	59	39	17	49	31	13
50 years	610	385	160	72	48	21	62	39	17
60 years	750	510	270	84	55	25	73	46	20
70 years	870	620	370	94	62	28	83	52	23

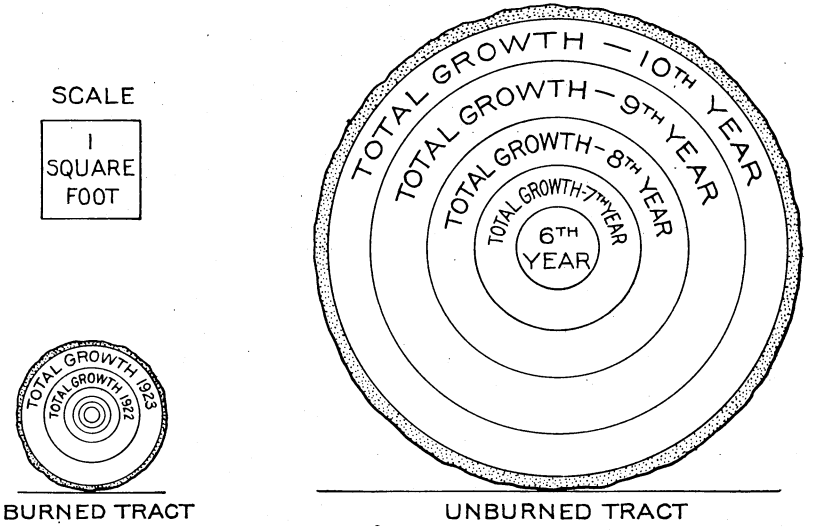

FIGURE 8.—Growth in cross section of the longleaf pines on two similar and adjacent tracts of one-fourth acre each, one unburned and one burned over yearly. Age when measured, 10 years. La Salle Parish, La. (The sum of the cross-sections of all trees on a tract is represented as one tree)

The yields of saw timber shown in Table 3 are the amounts that the timber tracts may be expected to cut at the various designated ages. They do not include the timber removed in previous thinnings, or the intermediate yield, often a very considerable amount.

As the trees in a stand grow, there is a natural thinning by the weaker trees becoming crowded out. The progress may be observed in any well-stocked stand in which are found dominant trees, others that are barely living, and still others that have died for lack of

overhead light, soil moisture, or root space. If these trees are cut and utilized, the total yield of the stand is considerably increased, and the stand is made more profitable.

TABLE 3.—*Saw timber per acre, measured in board feet, grown by longleaf pine in well stocked stands*

[Saw-timber yield table]

Age of trees	Estimate by international rule [1] from—			Estimate by Doyle rule from—		
	Good land	Average land	Poor land	Good land	Average land	Poor land
	Board feet	*Board feet*	*Board feet*	*Board feet*	*Board feet*	*Board feet*
20 years	2,500	900				
25 years	7,000	2,700	450	500		
30 years	11,500	4,500	900	2,000		
35 years	16,000	7,200	1,400	4,000	1,000	
40 years	21,000	10,000	2,300	6,500	2,000	
45 years	25,500	12,500	3,200	9,000	3,000	
50 years	30,500	16,000	4,500	11,500	4,500	500
55 years	35,000	18,500	5,400	14,500	6,000	500
60 years	39,500	21,500	6,300	17,000	7,000	1,000
65 years	43,000	23,500	7,200	19,500	8,500	1,500
70 years	46,000	26,000	8,100	22,500	9,500	2,000

[1] The International log rule used here shows fairly closely the yield of saw timber per acre under good methods of logging and sawing and using the circular saw (cutting a kerf one-fourth inch thick). See page 21.

NAVAL STORES PRODUCTION

Gum, or crude turpentine, has often been the more valuable product and, under wasteful practices of the past, the only money product realized from the tree. For many years it has been common practice to work longleaf pine trees as soon as they reached diameters from 6 to 8 inches, and after three to four years of working to abandon the stand. Usually the trees soon became greatly injured by fire. In this manner second-growth longleaf trees have been extensively destroyed.

With the rapid increase in the value of pine, modern practices of turpentine are improving. However, much longleaf pine timber is still being worked too small and too young, and chipping is generally made too deep into the tree and too wide up the tree.

To keep pace with the keen competition that exists in the naval stores industry the successful turpentine man needs to use methods that will give him the greatest possible gum yields, keep down the costs, and maintain the vigor of his trees. The growing scarcity of turpentine timber is causing timber owners to lease only to careful operators.

It has been found that the yield of gum is to a great extent influenced by the size of the trees. Such small yields are obtained from trees less than 9 inches in diameter that only occasionally is there any profit in working them. Beginning with a 10-inch tree, and working one low face at a time insures a high sustained yield over a period of years and the largest profit in the long run to both owner and operator.

What are some good practices in turpentining?

Suggestions are here made for good working in larger sized second-growth timber:

(1) Work no trees under 9 inches in diameter (at breastheight measured outside the bark). Trees to be removed in thinning young stands may be considered as exceptions to this rule.

(2) Work only one face on trees from 9 to 15 inches in diameter, and never more than two faces on any tree.

(3) Use the cup method. Under no condition use the old and wasteful "box" method. Careful hanging of cups and gutters prevents waste. Do not slab off the bark at the base of the tree.

(4) Use a No. 0 hack, as this permits cutting streaks three-fourths inch deep and one-half inch up the tree, known as light chipping.

(5) Hang the cups as low as possible to prolong the working life of faces.

(6) Chip a moderately narrow face—not more than one-third the circumference of the tree.

(7) Leave at least 4 inches of living wood (bars) between the faces on all trees.

(8) Following the season's working, rake clean for a distance of 2½ feet on all sides away from the base of each worked tree. (Fig. 9.)

Conservative methods are more profitable than heavy workings for turpentine, which "dry face" and destroy much timber.

What are some bad turpentining practices?

Unprofitable practices of working timber include: (1) Working too small trees; (2) chipping too deeply and too wide; (3) placing too many faces on trees; and (4) leaving insufficient width in bars between faces.

How much gum will a crop of longleaf trees yield?

A "crop" consists of 10,000 cups. In Florida the average yield per crop is 31 barrels (50 gallons each) of turpentine, while in the South as a whole the average runs about 35 barrels. About 3⅓ barrels of rosin are produced to each barrel of turpentine. A crop (or 10,000 cups) of longleaf pine trees, 7 inches in diameter (at breastheight) and worked with 32 streaks a season, should give an average yield of about 14 barrels of turpentine, 8-inch trees 21 barrels, 9-inch trees 27 barrels, 10-inch trees 34 barrels, 11-inch trees 40 barrels and 12-inch trees 46 barrels.

The yield of gum from longleaf pine trees is variable—a fact commonly recognized among operators. Much depends upon the thrift or "lushy" condition of the tree and the manner of working. The amount of foliage or top is important. Crowded stands of slow-growing trees on poor land will fall below the average yield· vigorous, heavy topped trees will exceed the average yield.

Does turpentining affect the timber in the tree?

Turpentining pine trees does not lower the strength or amount of resin in the wood. The crude gum is not drained from a store in the tree, but, under the stimulus of the wound, is manufactured by the living cells in the sapwood at the place where the wood is chipped. The heartwood is dead and does not produce gum, or resin, nor does gum exude from it if the wood is cut into. When turpentining is properly done, the loss from death of trees or the lowering of the grades of lumber are both very small. Any losses

are usually more than offset by the increased money returns from the naval stores products.

Does turpentining affect the growth?

Heavy working greatly checks the rate of growth. Conservative turpentining on second-growth trees, with one face per tree, checks

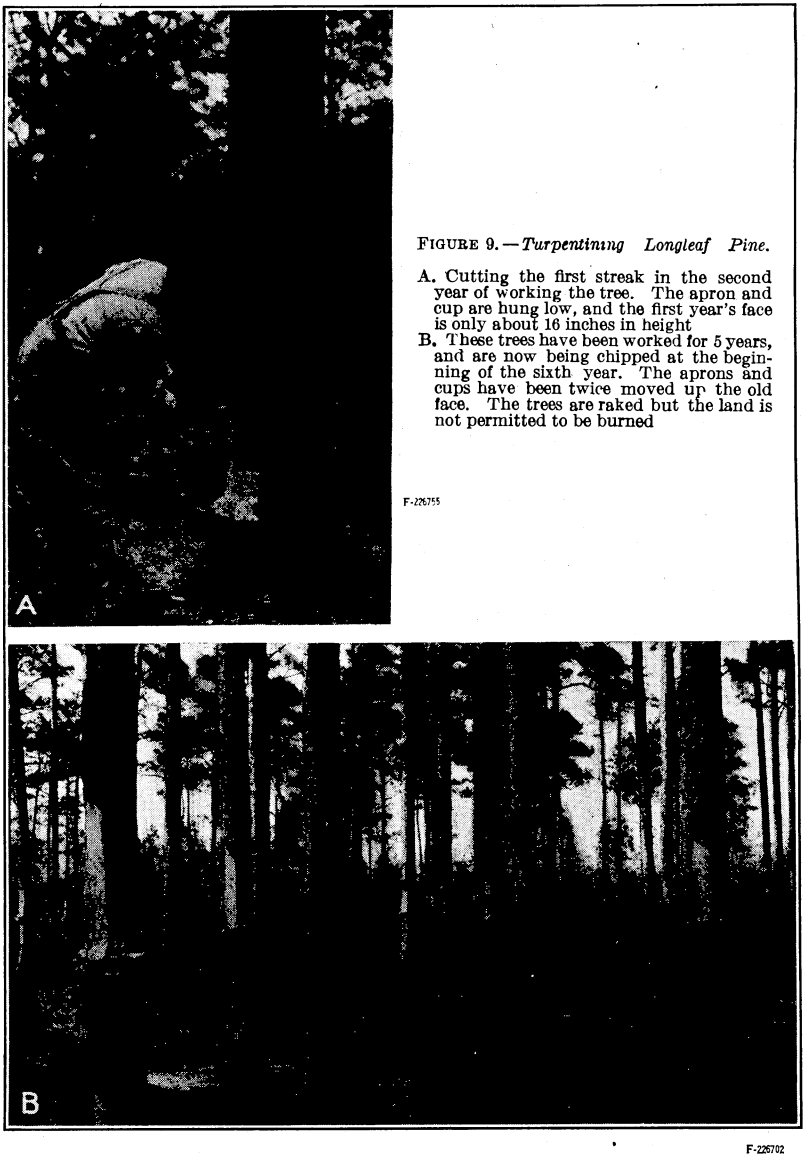

FIGURE 9.—*Turpentining Longleaf Pine.*

A. Cutting the first streak in the second year of working the tree. The apron and cup are hung low, and the first year's face is only about 16 inches in height

B. These trees have been worked for 5 years, and are now being chipped at the beginning of the sixth year. The aprons and cups have been twice moved up the old face. The trees are raked but the land is not permitted to be burned

the growth about one-third of normal; working two faces reduces growth nearly one-half its former rate. A natural healing-over growth takes place following the working of the tree, faster in the more vigorous and healthy-topped trees.

How should longleaf pine be managed for turpentine?

The common practice of owners has been to work their second-growth longleaf pine at ages from 20 to 30 years. The method has generally been to work the timber heavy with one face on all the smaller trees, down to 6 or 7 inches, and two faces on all trees possible—about 10 inches and over in diameter. This method has been destructive but profitable while it lasted, although unprofitable on the smaller sized trees. Such heavy working cuts down the total yield of gum, and in two or three years puts an end to most of the trees as producers of turpentine. A stand worked this way should be cut at once following the working. If the trees are neither cut nor killed by subsequent fires, some few may survive

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FIGURE 10.—Young trees that have been heavily chipped are usually badly broken by the wind. Sometimes as many as one-half of all the worked trees go down in a gale

and be reworked later. The common practice is usually accompanied by a heavy loss of timber. (Fig. 10.)

An improvement on this method that can be easily understood and applied starts turpentining the timber at about 20 years of age. It is then worked for 20 years, three times successively, with resting periods between each working. At the end, when about 40 years old, the stand may either be cut or held for increased growth. Working one face to the tree is a fixed rule. This system promises larger yield per cup and greater profit from the stand of timber than the heavier, more destructive method. With conservative working the growth of the tree is not seriously checked, and good yields of timber may be expected after the working. In starting the operation at 20 years of age, the profitable trees are selected and worked for four years, and then the stand is allowed to rest for three years. In poor soils growth is slow and the trees will not be large enough to be worked until several years later. Size rather than age deter-

mines the possibility of working. The second working is then begun. This time there will be more faces of profitable sizes to work. The working is followed by a 3-year rest. The final cupping is then carried on for four years. The stand is now about 40 years old and may be cut for timber, as it has reached merchantable size. As the stand has been properly tended, conservatively cupped, and is growing at a good rate, it may be held for 10 or 20 years for a profitable increase in size and value. The market conditions and personal situation of the owner will largely determine the final disposal of the timber.

Can longleaf pine be profitably worked under the French system?

The French have developed a more intensive system that is very profitable. They begin at about 20 years and work heavily the smaller trees they wish to thin out, repeating the process in five years or so. Thus they aim to develop a stand of the largest and best trees, uniformly spaced. Then they begin to turpentine the trees and work them conservatively for 30 to 40 years, or to an age of 60 to 70 years. The trees are then cut for lumber and other products.

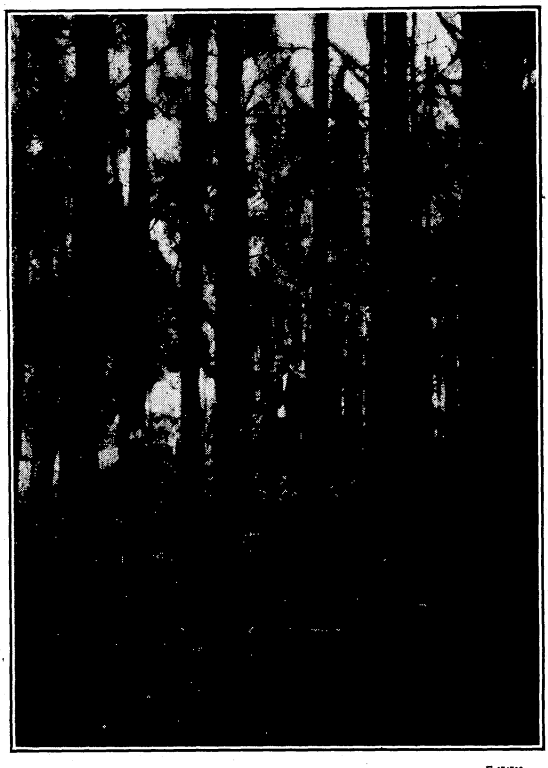

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FIGURE 11.—Longleaf about 20 years old in need of thinning. The suppressed, and a few of the medium-sized, trees should be cut out

Experiments by the Forest Service on the Florida National Forest indicate that it is possible to work second-growth longleaf pine by the French system. The very narrow faces of the French system allow a much longer operating period, during which the tree continues to grow until it becomes large enough for the saw. The difficulty, however, of getting suitable skilled labor, together with the higher wage scale in this country, tend to defer the time when the French method can be generally recommended as practicable.

THINNINGS

Why are thinnings necessary in growing pines as a crop?

As in a stand of corn or cotton, the trees in a full pine stand grow, crowd upon each other, and the stronger trees gradually crowd out the weaker. (Fig. 11.) Too few trees on an acre result in bushy

tops and knotty lumber; too many trees mean a slowing up of individual growth. There is a right number, varying with the age and location. Thinnings are made to keep ahead of nature and reduce the number of trees, so as to obtain the maximum growth of the kind of product desired.

How should thinnings be made?

There are two ways of thinning pine stands. In a "low" thinning (fig. 12) the smaller, less vigorous, diseased, and unpromising trees are taken out.

"Low" thinning favors the largest and best trees and more nearly keeps the timber production at its capacity. Size counts much in the value of the timber. The first principle is to wait until the trees to be removed have reached a merchantable size, so that the thinning may at least pay for itself, or, better still, make a profit. The material removed may be used for firewood, pulp wood, or small saw timber. Longleaf pine will be large enough for a first thinning at ages generally from 15 to 20 years. An idea of the number of trees per acre in full stands of different ages can be obtained from the last column of Table 1. This is only an approximate average with a rather wide range.

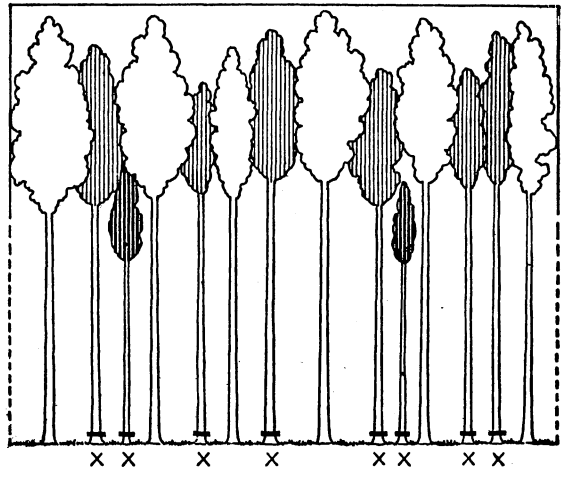

FIGURE 12.—How to thin longleaf pine. Low thinning is a good method. This method of thinning removes the overtopped and other slow-growing and defective trees and utilizes them before they die from natural crowding. This increases both the growth and the value of the more vigorous trees. Longleaf pines should be worked for turpentine two to four years before being cut. (The shaded trees are marked to be cut)

In a "high" thinning the opposite is true, and the larger or dominant trees are cut, thus making more room for the smaller trees to expand. The most common practice of owners is to cut out the largest trees, because they are the first to become merchantable. (Fig. 13.) That which happens then is the gradual recovery of the formerly stunted trees to a normal growth. This adjustment generally requires a few years, during which there is a loss in the growing power of the land. On the better qualities of soils, the recovery of suppressed longleaf pine trees may be expected to take place satisfactorily.

Should thinnings of pine be made in the summer?

Thinnings can be safely made at any time of the year except during the period from April to September, when certain beetles are active. These beetles are attracted to the freshly cut pine timber and often attack the near-by living trees. On page 23 there will be found additional information on this subject.

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CUTTING THE CROP OF PINE

When should the main timber crop be cut?

Many considerations should enter into making a decision as to when the crop of longleaf pine trees should be cut and another one started. If several successive thinnings have been made, the remaining trees will be fairly uniform in spacing and in size. The kind of product to be obtained, whether saw logs, piling, crossties, or pulp wood depends upon such factors as the location of the timber with reference to the best markets, prevailing prices of the various commodities, and cost of marketing the product.

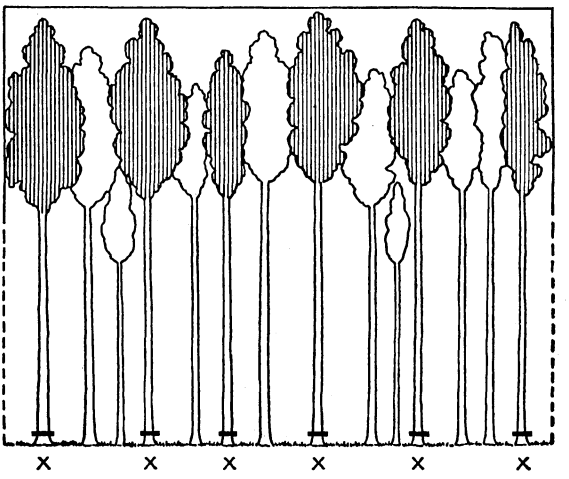

FIGURE 13.—How not to thin longleaf pine. High thinning is an unprofitable method. Here the larger, more rapidly growing trees are marked for cutting. This is rather common practice. The smaller trees have become stunted, and after the larger trees have been cut usually two to four years will be required for them to recover and grow at a satisfactory rate. (Shaded trees are marked to be cut)

The main crop of longleaf pine timber should, generally speaking, be ready for pulp wood at an age of 25 to 35 years, for ties at 30 to 40 years, and for saw logs at 40 to 50 years. This assumes growing the crop under fire protection, the only way to make timber growing most profitable.

What is the right way to cut the main crop of longleaf?

Before cutting the stand, from three to five trees capable of producing large crops of seed should be selected to remain standing on each acre. The number will vary with the size of the trees. A longleaf pine seed tree should be not less than 9 inches in diameter at breastheight (4½ feet above ground), healthy, as young as possible, and with a vigorous or "lushy" top. These have usually grown open or apart from others. To mark these so that they will not be cut by the sawyers, the seed trees should be spotted with white paint or whitewash uniformly on the same side of all the trees. By this "seed-tree" method and with adequate protection from fire and razorback hogs, a full stand of young growth should become established on the tract during the next three to five years after logging.

A good way to start another crop of pines without delay is to cut the trees in the fall just after maturing a heavy crop of seed. Logging makes a favorable seed bed and stirs up the seed in the soil. If the market conditions for the cut product are favorable at that season, this method of cutting all the trees and restocking the land may well be used wherever possible.

Important rules for good logging of longleaf pine are:

1. Leave three to five "lushy" topped seed trees in each acre;
2. Cut low stumps, not over 12 inches above the ground (fig. 14);

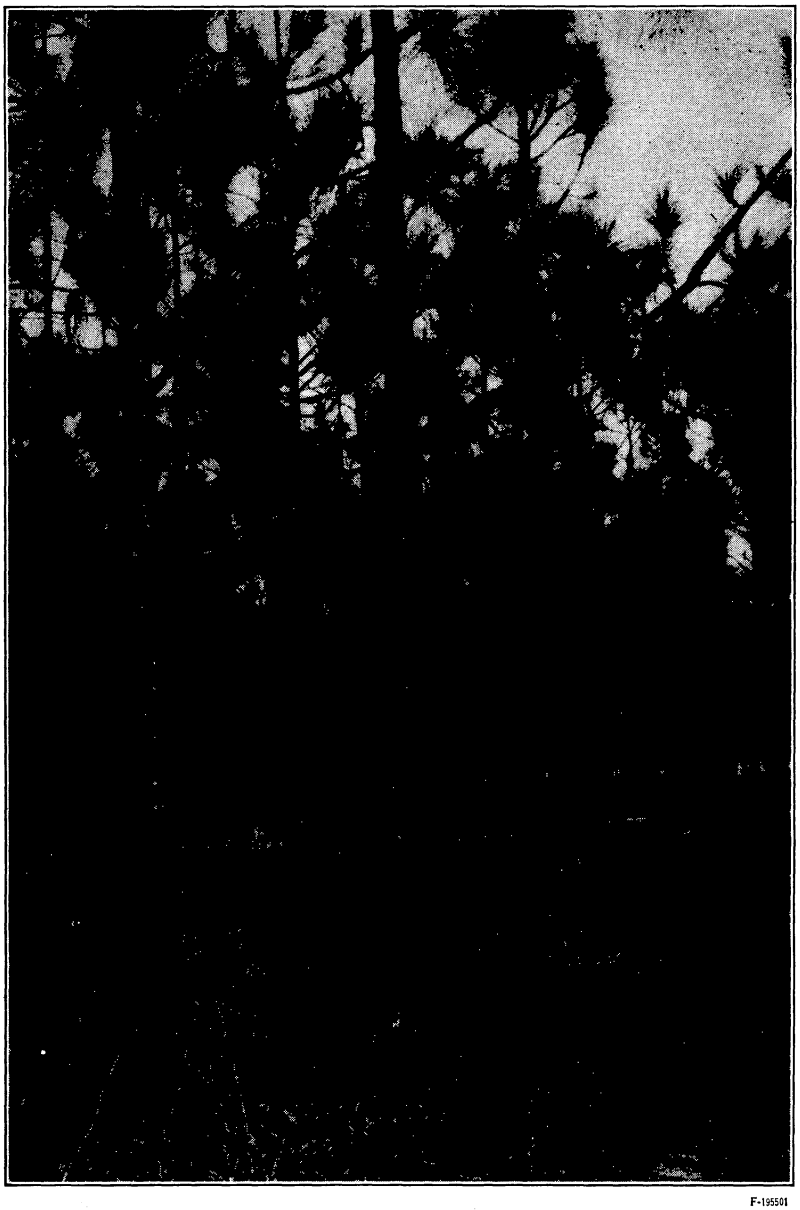

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FIGURE 14.—This is the way nature will bring back the longleaf pine forest when given a chance by means of seed trees and protection. Unfortunately, much timber was wasted in high stumps

3. Fall each tree so as to do the least injury, especially to the young growth;

4. Utilize the tops for firewood and leave no branches beneath or near living trees, in order to safeguard against possible damage by fire and insects;

5. Guard carefully against fire at all times.

How many board feet of saw timber are there in second-growth longleaf pine trees of different sizes?

The approximate number of board feet contained in longleaf pine trees is shown in Tables 4 and 5. This assumes cutting stumps 1 foot high, using the tree down to a diameter of 5 inches (inside the bark) in the top, and scaling by the International log rule (see Table 6), using a saw one-fourth inch thick.

TABLE 4.—*Saw timber in board feet contained in longleaf trees of different heights and diameters*

[Trees scaled to 6-inch diameter in tops]

Diameter of the tree [1] (inches)	Total height of the tree in feet						
	40	50	60	70	80	90	100
	Contents of trees in board feet						
7	7	14	22	29	35	----	----
8	9	20	31	42	52	----	----
9	12	27	42	58	73	86	----
10	15	36	57	77	97	115	131
11	----	----	74	100	124	147	167
12	----	----	91	121	152	180	205
13	----	----	109	146	181	215	245
14	----	----	124	166	206	244	281
15	----	----	138	184	229	272	312
16	----	----	153	204	254	302	348
17	----	----	169	226	281	332	381
18	----	----	187	248	306	360	414

[1] Measured outside the bark at breastheight, or 4½ feet from the ground.

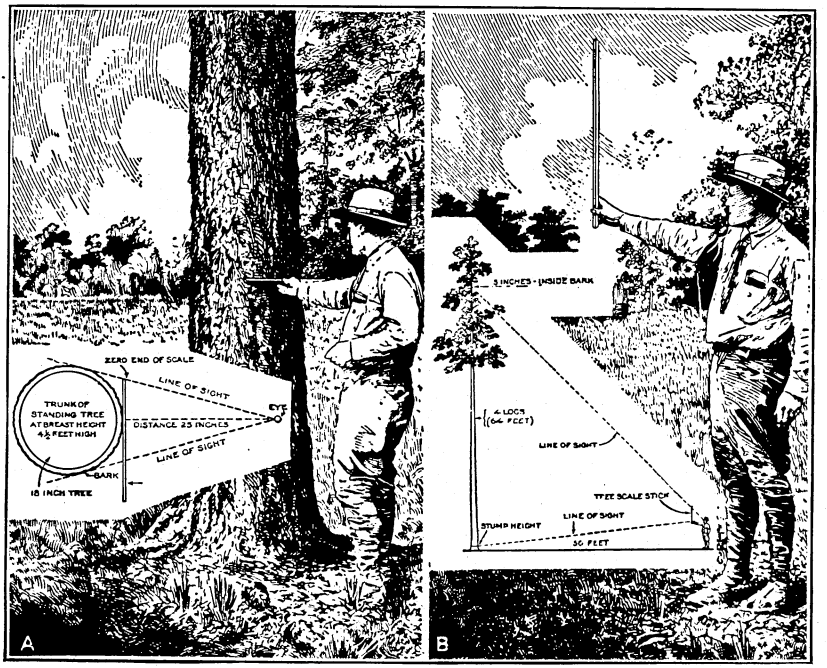
TABLE 5.—*Saw timber in board feet contained in longleaf trees of different merchantable log lengths (16 feet each) and diameters*

[Trees scaled to 6-inch diameter in top]

Diameter of tree [1] (inches)	Number of 16-foot logs in tree					
	1¼	2	3	4	5	6
	Contents of trees in board feet					
7	17	26	40	----	----	----
8	19	33	53	74	----	----
9	21	41	68	96	124	----
10	24	48	82	117	152	190
11	26	55	97	139	182	224
12	29	62	112	163	213	263
13	----	71	127	187	244	304
14	----	78	143	212	277	346
15	----	85	160	238	312	391
16	----	93	178	265	350	438
17	----	101	197	293	390	488
18	----	110	216	322	430	538

[1] Measured outside the bark at breastheight, or 4½ feet from the ground.

To estimate the contents of a tree, the diameter outside the bark (at breastheight, or 4½ feet above the ground) and the total height or the number of 16-foot log cuts are ascertained. For example, a tree measuring 14 inches in diameter (outside the bark at breastheight) and 60 feet in height contains (Table 4) about 124 board feet. Or, a tree measuring 14 inches in diameter and having three merchantable 16- foot logs (Table 5) contains about 143 board feet. If the tree is



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MEASURING TREE DIAMETERS AND TREE HEIGHTS BY USE OF TREE SCALE STICK

FIGURE 15.—Estimating the saw timber in a tree by the use of a tree scale, or cruiser's stick. A, If the stick is held horizontally against the trunk of the tree at a specified distance from the eye, the observer is able to read directly the diameter of the tree outside the bark. B, The stick is graduated so that, when held a specified distance from the eye of the observer who stands a specified distance from the tree, the observer can read the number of 16-foot log lengths in the tree. The principle is that of two similar triangles. NOTE: Tree-scale sticks made for use on "shortleaf yellow" or "hill shortleaf" pine trees may be used with fair accuracy for longleaf pines

crooked or otherwise defective, a corresponding reduction in scale should be made.

Various kinds of tree-scale sticks, or "cruising" sticks, are coming into popular use. They are used to measure the diameter and the height, or the number of logs, in a tree. One is known as the Biltmore stick. Sticks of another class also show for trees of different diameters and number of 16-foot cuts, the number of board feet of saw timber that can be cut out. (Fig. 15.) A handy set of tree-scale and log-scale sticks, applicable for use in scaling logs of all kinds and trees of the four important kinds of southern pines, is distributed at cost ($1) by the American Forestry Association, Washington, D. C. For estimating the contents of longleaf pine trees the values shown on the tree scale for "shortleaf yellow" pine are applicable and should

be used. The scales for both trees and logs are shown by the Doyle and by the more accurate International rules.

How should timber be sold?

The owner should sell his timber (1) by the thousand feet scaled in the stack (sawmill tally) or scaled by a log rule which shows in a fairly accurate way what is in the log (the Doyle rule does not answer for small timber); or (2) by the boundary or tract of land when he has a reliable estimate of the amount of timber that can be cut out by careful sawing. The mill tally is recommended wherever possible. If not, then use a rule such as the International, which comes nearer full utilization than any other rule. Unscrupulous buyers are ready to take advantage of those who do not know the amount or value of their timber. Buyers are entitled to no more than a fair profit. The farmers have not been receiving their share of the value of their timber crop. Also many of the trees for which they have failed to receive pay have been wasted by carelessness in cutting and handling.

Is there any difference in what log rule is used for measuring and selling, timber?

Yes, a great difference in respect to both the amount of timber and the resulting money return.

The Doyle rule, although the legal rule in a few States and in common use in the South, is unfair to the seller for logs below about 28 inches in diameter. In the early days of large and cheap virgin timber, when narrow and knotty boards were worthless, it was fairly satisfactory, but for scaling small-sized timber, such as second-growth southern pine, it gives such small volumes for small logs as to make it unsatisfactory. On the national forests, the Scribner rule (in the decimal C form) is standard. It is more fair than the Doyle rule for small logs, but reasonably careful sawing should result in obtaining from 10 to 20 per cent more lumber than even this rule gives for second-growth timber.

For small timber, such as second-growth pine, the International log rule (Table 6) gives log volumes which are very close to what can be sawed out by using good methods. Careless sawing will give a lower volume of square-edged boards than the logs scale by this rule, so that it gives the mill man a chance to test his own efficiency in this respect. Producers of small logs will benefit when this or some equally close rule has come into general use. The sale of logs by the International rule or by the mill tally is recommended.

As a comparison, a log measuring 10 inches in diameter inside the bark at the small end and 16 feet long when carefully sawed with a circular saw of ordinary thickness (¼-inch kerf) should, by the International rule, turn out 65 board feet. The same log scaled by the Doyle rule shows 36 board feet, or only about one-half the amount that can be actually sawed and that is credited by the International rule.

Is there any further available information on how to measure and how to market timber?

Some of the State forestry departments and State colleges of agriculture have publications on this subject. The United States Department of Agriculture, upon request, will furnish copies of Farmers' Bulletin 1210, Measuring and Marketing Farm Timber.

TABLE 6.—*The contents of logs, in board feet, scaled by the International log rule (using saw cutting ¼-inch kerf)*

Diameter at top end of log, inside bark (inches)	Contents (in board feet) of logs having a length of—						
	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet
6	10	10	15	15	20	25	25
7	10	15	20	25	30	35	40
8	15	20	25	35	40	45	50
9	20	30	35	45	50	60	70
10	30	35	45	55	65	75	85
11	35	45	55	70	80	95	105
12	45	55	70	85	95	110	125
13	55	70	85	100	115	135	150
14	65	80	100	115	135	155	175
15	75	95	115	135	160	180	205
16	85	110	130	155	180	205	235
17	95	125	150	180	205	235	265
18	110	140	170	200	230	265	300
19	125	155	190	225	260	300	335
20	135	175	210	250	290	330	370
21	155	195	235	280	320	365	410
22	170	215	260	305	355	405	455
23	185	235	285	335	390	445	495
24	205	255	310	370	425	485	545
25	220	280	340	400	460	525	590

PROTECTION

Does burning injure longleaf pine?

Fire seriously injures or kills longleaf pine. Although the longleaf is probably more fire resistant than any other of our native pines,

F-195171

FIGURE 16.—Frequent fires destroy the vegetable matter over the soil, retard the growth of the trees, and result in enormous loss to the owners. Such fires as this explain why the South's young pine is growing only at about one-third to one-half as fast as it should

every fire takes its toll, and it is safe to say that hundreds of millions of longleaf pine trees have been killed by fire in the past five years. (Figs. 16 and 17.) Fire injures the tree directly, and indirectly, by removing the protective ground cover of straw which acts as a mulch in holding soil moisture.

During about the first 18 months the young tree consists of a small bunch of tender straws (looking much like green grass) and is very easily killed by grass fires. After this until about the fifth or sixth year of age, the heavy "skirt" of green straw protects the central stem so as to make it relatively very fire resistant. Then follows the period of rapid height growth and the stem is much more susceptible to injury by fire.

Each fire that strips the foliage retards the growth and lowers the vitality of the tree. Repeated slow fires or one hot fire will usually kill young longleaf pines up to 4 to 6 feet in height, or in age from 5 to 15 years. Additional information and a concrete example of

F-195190

FIGURE 17.—Millions of dollars in timber burn up yearly. The big problem of forestry in the South is fire protection. Woods fires cause an appalling money loss in timber, soil fertility, buildings, and forage. When the people come to realize what these losses mean in their economic progress, the number and extent of woods fires will rapidly decrease. "Fire is the crime of all crimes to woodland"

how burning checks the rate of growth of longleaf pine are given on page 8. It pays to protect pines.

How do razorback hogs damage longleaf?

The native "razorback" or piney-woods hog is one of the greatest enemies of young longleaf pine—in this respect probably second only to fire. It consumes large quantities of the seed or mast, and destroys vast numbers of saplings, eating the thick, succulent bark on the taproots. The heaviest losses occur at ages of from 2 to 5 years, but trees up to 10 years are frequently found seriously injured or killed. On one acre in Texas the hogs killed during one spring more than 6,000 longleaf seedlings that were making their third year's growth. (Fig. 18.)

Where razorbacks are present, it is necessary to protect longleaf pine tracts with hog-proof fence in order to establish young growth longleaf pine. The blooded hog is not known to cause any appreciable damage, except when closely confined.

Are the "worms" or beetles that attack living pines the same as the "sawyer" or "flat head" which works in cut, or down, timber?

No. The southern pine beetle is a small brownish beetle, which lays its eggs beneath the bark, preferably in sickly or injured trees. These hatch into grubs or so-called worms that feed on the rich living layer between the bark and newly formed sapwood. In the hot months from May to September this beetle is attracted to localities where timber is being cut and is likely to attack healthy living trees.

The "sawyer" belongs to a different genus of insects and works exclusively in dead or cut timber.

Additional information, including methods of control of these insects, will be found in Farmers' Bulletin 1586, The Southern Pine

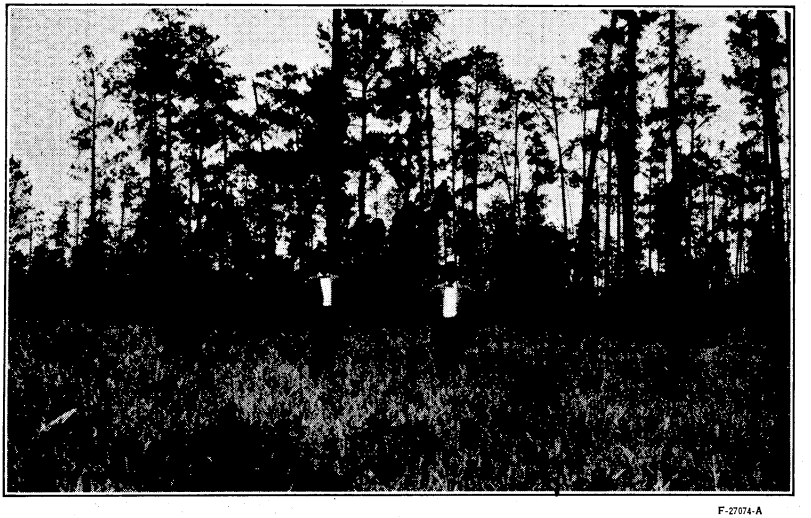

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FIGURE 18.—Razorback hogs have destroyed vast acreages of young longleaf pines These men have picked up 38 small longleafs from a square rod, or at the rate of about 6,000 per acre, killed by the razorbacks. Fire and native hogs have kept this land, cut 20 years ago, from reseeding to pines

Beetle, or may be had upon application to the Division of Publications, United States Department of Agriculture.

Is young longleaf pine subject to any disease?

A disease known as "brown spot" is fairly common in the foliage or leaves during the first 6 to 10 years of its life. This is more noticeable in "rough" land than where the grass cover is kept down by grazing or burning. The disease checks each year's development or growth and sometimes proves fatal. It would be a costly mistake to attempt to burn over land in order to kill out the "red spot," because of the far greater damage done by fire to the pines and to the organic layer over the soil.

A disease is known sometimes to attack the young immature burs, causing them to die.

The "damping off" fungus, referred to under the general subject of reforestation and the growing of longleaf pine seedlings in nursery beds, is a menace only during a few weeks in the very early life of the seedling.

The fungi which cause redheart or "red" wood usually work in the old, overmature trees. They are not at all common in second-growth or young timber. If fuller information is desired concerning any of these diseases, the reader should get in touch with the State officials, or the Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

Should longleaf pine lands be grazed?

Following the cutting of pines, there is a period of some five years required for satisfactory restocking of the land. During this period, or longer if required for the little trees to become established and begin their upward stem growth, the land should not be heavily grazed. Light grazing of cattle, horses, mules, and possibly sheep can be done without serious damage. Goats and hogs must be excluded. After the trees have reached heights of 5 to 8 feet (ages 6 to 8 years), pasturing will do no appreciable damage unless the stock is closely herded. There is no place for the razorback hog in farm or forest management.

REFORESTATION BY PLANTING SMALL TREES

Can land be reforested by planting young longleaf pine?

The surest method of reforesting land with longleaf pine appears to be by setting out young seedlings. (Fig. 19.) Only a little has been done thus far, so that our present knowledge is limited.

Because of the large, stout taproot which begins to form the first year of growth, the planting of seedlings should not be attempted on a large scale if they are more than one season old. Older trees might be successfully transplanted if great care were used, but such operations would be altogether too costly for forest plantations.

After many observations and some experiments it has been found that the seed of longleaf pine is poorly adapted for reforesting land by means of direct seeding. Thus the better method is to plant young seedlings.

How can longleaf pine seedlings be obtained?

They may be dug up in the woods or grown from seed sown in a prepared nursery bed. The latter is nearly always the more practicable method. It is rare to find dense patches of longleaf pine seedlings of the right age, and the collection of scattered individuals is costly.

Commercial nurseries are beginning to grow supplies of longleaf pine. Under the Clarke-McNary Act the various States in the South are becoming increasingly interested in growing forest-tree seedlings for public distribution, at about the cost of production. (Fig. 20.) Applications should be made to the State department or commission of forestry.

Where can longleaf pine seed be obtained?

Pine seed or mast is borne in the burs or cones. Upon examination of a bur just after it has matured and opened in the fall, two small seeds, each with a long wing, will be found deep down at the base of each scale of the bur.

Pine seed is most economically obtained from trees felled in logging. The seed is ripe and may be collected any time after the burs

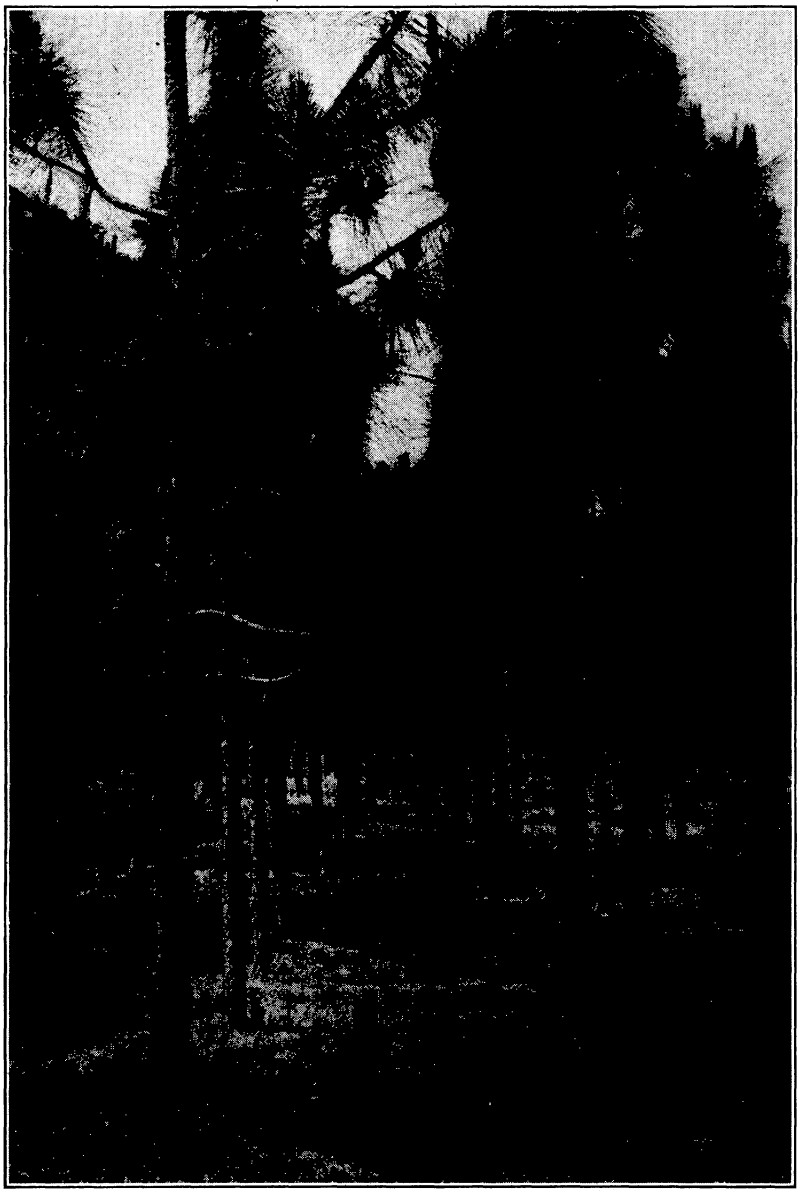

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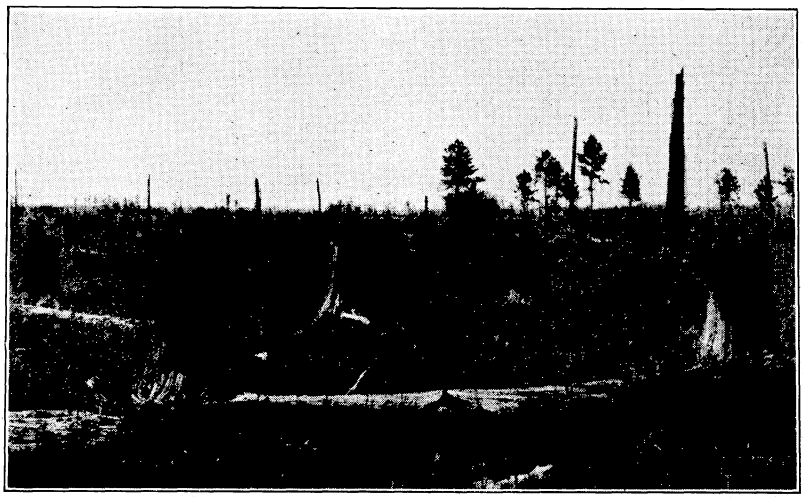
FIGURE 19.—Land reforested by planting longleaf pine seedlings 6 feet apart in furrows. The trees are about 12 years old

begin to turn brown in the fall. The burs should be pulled off the tops, collected in burlap or gunny sacks, and later spread out to dry

on a tight floor or on canvas in the sun. In drying weather they will open in a few days, and if the burs are then beaten or stirred the seeds will fall out. The wings cling tightly to the seed and in ordinary practice no attempt is made to break them from the seed. Sometimes the seed may be quickly obtained directly from the felled treetops by beating the open burs with a stick while holding a sack, tub, or bucket under them. There are usually 5,000 longleaf pine seeds in a pound.

In favorable seasons and where logging is in progress longleaf pine seed has been collected for as low as 50 cents a pound, but it often costs from $1 to $2. Commercial dealers make an additional charge for handling and to pay for some inevitable loss in order to keep fresh stock on hand. The seed commonly retails at $2 to $3 per pound.



F-167140

FIGURE 20.—For 25 years, since the longleaf pine forest was cut off, this land has produced nothing except wire grass. It must be sowed or planted with pines and protected from fire and hogs if it is to be put to its most profitable use

At intervals of every few years the seed is abundant because of heavy seed crops. Inquiries as to where longleaf pine seed may be obtained, including a list of commercial dealers, should be directed to the State forester, the extension forester at the State agricultural college, or the Forest Service, Washington, D. C. One factor in the cost of longleaf pine seed is its rapid deterioration in germinative power. Fresh stock should always be specified in orders for pine seed.

How should the nursery bed be made and sown?

A garden bed or nursery bed 3 feet wide and 12 feet long is suggested. This should be on level ground, an inch or so above the general surface. It should be in some convenient place near the house or barn, and have a supply of water near by. For large-scale operations, the beds should be longer. (Fig. 21.)

The seed may be sown at once after collection (if early in the fall) or otherwise held over and sown in early spring. An inch of woods dirt, fine sand, or stream silt should be spread over the bed to provide acid soil and one as free as possible from weed seed. Old garden soil

is very likely to be infested with a serious "damping-off" fungous disease as well as to contain weed seed and grass. The "damping-off" disease does not thrive in an acid soil. About 1 pound of longleaf pine seed for each bed of 36 square feet is then sown evenly and firmly pressed into the soil with a roller or heavy plank. Another good way is to sow the seed in drills (rows or lines of seed on top of the soil rather than in actual drills) sowing about 20 seeds per running foot, with drills spaced about 5 inches apart. The beds should then be covered with fine or broken-up pine straws, preferably that from shortleaf or oldfield loblolly pines. A good method of mulching and covering the sown bed, especially in spring sowing, is to use burlap or sacking.

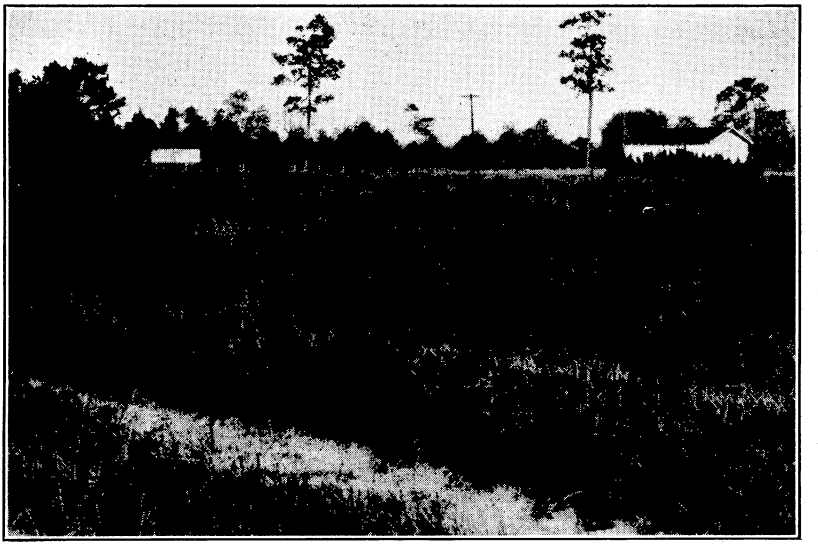


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FIGURE 21.—Thrifty longleaf pine seedlings in nursery beds, 1 season old and ready for planting out, look like dense masses of coarse grass

This covering requires particular attention for it must be removed as soon as the seed begin to germinate.

If seeding is not done in the fall, the seed should be carefully stored over until spring. The essentials are to keep it cool and especially to prevent excessive drying. The large nutritious seeds of the longleaf appear to deteriorate more rapidly than do the smaller seeds of other pines, mainly from drying out and frequent changes in temperature. The sowing should then be done in the spring while there is good moisture and warmth in the soil. The soil in the seed bed must be kept moist during the period of germination.

Generally about one-half to two-thirds of the longleaf pine seeds are fertile. This should result in about 3,000 seedlings to the bed at the end of the season, allowing for various kinds of enemies and unfavorable conditions. A desirable density for a final stand of longleaf seedlings is about 40 on each square foot of seed bed, or about 10 per running foot of drill. If the stand of seedlings is denser than this it should be thinned in early summer by clipping off (not pulling) the tops of the weaker or cull seedlings.

How should the nursery bed be protected and cared for?

Protection is very necessary after the seed is sown. It may be necessary to start with seed beds completely protected on sides and top with wire screen so as to keep out chickens, birds, rats, and mice. One-half-inch builders' wire cloth is perhaps the best material. Moles occasionally cause trouble and may be kept out by encircling the bed with a narrow trench filled with lime, or by sinking a strip of half-inch wire mesh to a depth of 1 foot around the bed.

Shade over the beds is seldom necessary for longleaf seedlings, provided they are of proper density and are watered in dry weather. Watering during dry periods in summer is essential, since the large number of seedlings closely spaced in one bed require much moisture. One thorough watering is much better than several shallow or surface wettings. The bed should be kept free of weeds at all times, and these should be pulled out when small, otherwise injury will result.

A damping-off fungus, which attacks young, tender pines at the surface of the ground, is likely to make inroads upon longleaf pine, particularly if grown in a nonacid soil. If young seedlings should become affected and wilt, the bed should at once be better ventilated. A layer of dry sand sprinkled thinly over the surface often helps to check the spread of the disease. Lime should never be used, as a sweet or alkaline soil is favorable to the spread of the fungus.

When should pine seedlings be planted?

The best time to plant small pines in the South is apparently in the early spring before the buds swell or the sap rises. This will vary with the location, from late January in the southern portion to March 15 in the more northern part of the longleaf pine belt. After the late fall rains come, the planting may be started, particularly in large operations which extend over many weeks.

How should small longleaf pine trees be planted?

The seedlings should be carefully dug and lifted from the nursery bed so as not to damage unnecessarily the fine rootlets. The taproot, if over 8 to 10 inches long, should be pruned back with a sharp knife. A well-sharpened shovel blade makes a good tool to prune the roots in the ground before the seedlings are lifted or dug. The roots at all times must be kept wet; hence the seedlings should at once be placed in tubs or buckets or wrapped in wet moss or gunny sack. If not wanted at once for planting, they should be "heeled in" in fresh soil, always in a cool, shaded place, and the soil never allowed to dry out. The leaves should be left exposed freely to the air, but never to direct sunlight.

A good method of planting in open land is to mark the land off roughly with a cultivator point or other light soil scratcher pulled by a horse or mule. The land should not be furrowed. If the rows are 8 feet apart and the small trees are set 5½ feet apart in the rows it will require 1,000 trees to plant an acre. This should prove a good average spacing. A closer spacing would be beneficial during the first 10 years or so, but would require thinning earlier than a more open spacing. A spacing of 6 feet apart each way will make a stand of 1,210 trees per acre. This is often desirable, especially on the thinner and dryer soils where growth is relatively slow.

During the first three years or more longleaf forms no stem and only a cluster of leaves and terminal bud. Too much emphasis can hardly be given to the necessity of care in planting longleaf seedlings so that after being planted they will stand a full half-inch higher than they grew in the nursery beds. This is to prevent, if possible, the soil from silting over and killing the central terminal bud.

Some essential points in good planting of small trees follow. A hole is opened only a little larger than is needed to spread out the roots. Holes are often dug too large and trees left too loosely set in the ground. A mattock ("mattax") or a grubbing hoe is a good tool for use in planting. The seedling tree is set with the roots spread in as natural a position as possible, the taproot being kept always straight down. Soil is then scraped in about the tree and

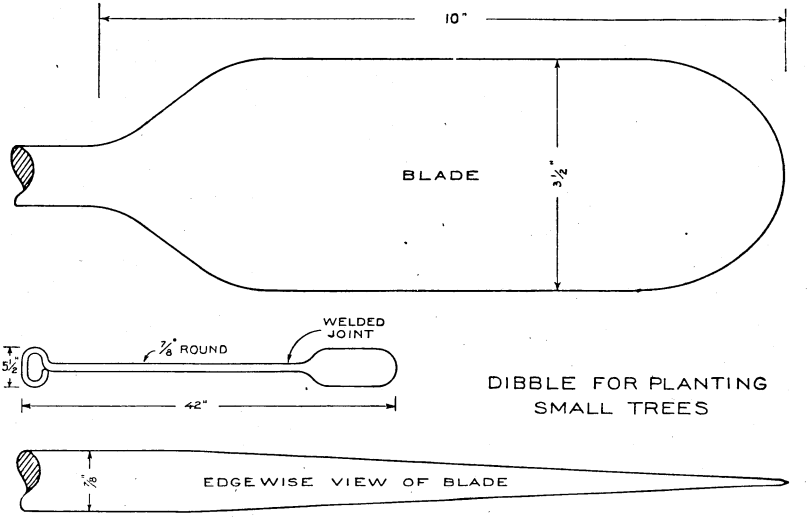

FIGURE 22.—A good tool for planting small forest trees is the dibble. The blade is of steel, 3½ by 10 inches and tapers in thickness as shown from seven-eighths inch down to an edge. The handle is of ⅞-inch iron and welded to the blade

then firmed, and the filling-in and tamping process is usually repeated in order to avoid rapid drying out. The sole of the shoe will be found suitable for this purpose. A little straw or loose soil scraped about the tree will act favorably as a mulch against rapid drying. The trees to be planted should be carried about in buckets and the roots kept in water, wet moss, or a clay puddle.

In loose or sandy soil, planting has often been done successfully and cheaply by the use of a dibble. This tool consists of a narrow, thin, flat and tapering steel blade about 3½ inches wide by 10 inches long, with a handle made from ⅞-inch iron. (Fig. 22.) With the dibble a narrow slit is opened by one or more straight downward thrusts. (Fig. 23.) A seedling is then inserted and held in position one-half inch higher than it grew by the other man in the crew of two, while the first man closes up the bottom of the hole by thrusting the dibble diagonally into the soil about 4 inches away from the seedling and giving the handle a leverage pull away from the first slit. The top of the hole is filled in in part by a slight forward motion as the dibble is removed and in part by soil kicked in and pressed with the worker's shoe.

Advantage should be taken of favorable weather. Cloudy weather following rains affords ideal conditions. After planting, no further attention is practicable except to protect the trees at all times from fire and hogs or other injurious livestock.

COST OF GROWING LONGLEAF PINE TIMBER

What does it cost to plant small longleaf pines?

A cost of about $5 an acre for reforesting by planting small trees is probably a fair average estimate, including all material and labor. (Fig. 24.) The items would be divided somewhat as follows: Cost of growing 1,000 year-old seedlings in nursery bed, about $2, marking the planting rows 50 cents, and planting labor about $2.50, a total of $5 per acre. The size of the operation influences the cost. One lumber company planted hundreds of acres at a cost of $4 an acre. If the landowner does not figure his time in looking after the nursery beds, the actual cost will be about 50 cents for the purchase of seed

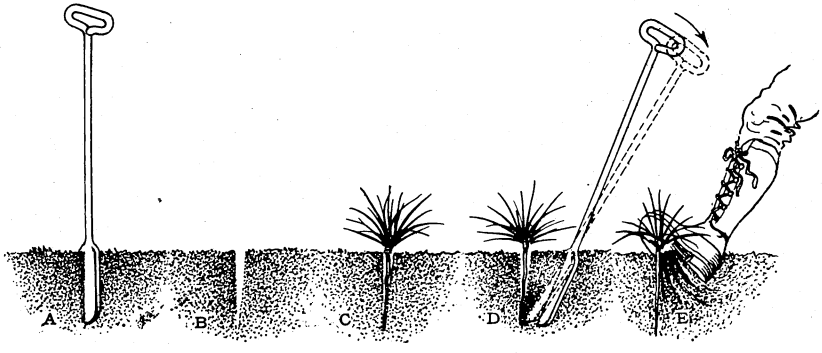

FIGURE 23.—Planting longleaf pine seedlings with a dibble as planting tool: A, Insert dibble vertically into the ground the length of the blade; B, withdraw dibble from slit; C, insert small tree carefully with root straight in slit; D, insert dibble, pressing soil against root by movement shown by arrow; E, complete the planting by forcing the surface soil with the heel of shoe

for sowing the nursery bed, 50 cents for marking the land, $2.50 for labor in planting the trees, or a total of $3.50 per acre.

What does it cost to grow a crop of timber by natural reforestation?

The items which enter into the cost of growing timber which has started naturally from seed trees are (1) the interest charges on the value of the land, (2) the annual taxes, and (3) the cost of protection during the period of growth.

The cost of growing a crop of timber that is now 40 years old (a fair age for mature second-growth longleaf pine), figuring the above items on the basis of 6 per cent simple interest for 40 years, amounts to $24 per acre. Figuring a total production of 12,000 board feet, this is an average of $2 per thousand board feet.

Interest on a land value of $5 per acre	$12
Taxes and cost of protection: 20 cents per acre yearly for 20 years; 40 cents per acre yearly for 20 years	12
Total cost of growing an acre of timber	24
Cost of growing a thousand board feet of timber (assuming a total yield of 12,000 board feet per acre at 40 years, or 2,000 from thinnings and 10,000 in final yield)	2

It does not seem fair to reckon the cost of growing timber by compound interest at a rate as high as 6 per cent, as it is understood that large long-time investments generally do not promise that much profit. Using the same land value and other factors included in natural reforestation, the cost of producing an acre of saw timber reckoned on a 4 per cent compound interest basis, amounts to $41.86. This makes an average cost of $3.49 per thousand board feet of timber where the total timber crop is 12,000 feet.

Some idea of the estimated profit in growing a crop of timber, starting with the bare land, can be obtained by reckoning 12,000 board feet—a fair yield for thinnings and final yield—at an average value of $8 per thousand, the assumed probable value on the stump at the end of the next 40-year period. This gives a total value of

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FIGURE 24.—A farmer and county agricultural agent starting a reforestation demonstration in south Mississippi. This cut-over longleaf pine land has been part of the farm, but has produced little of value, yet taxes have had to be paid every year

$96 per acre. Since the total cost of the acre of timber, on a 6 per cent simple-interest basis, was $24, and on the basis of 4 per cent compound interest was $41.86, the difference would be the additional profit over and above a fair return on the investment. This extra profit amounts to $72 per acre for naturally started longleaf pine, on the basis of 6 per cent simple interest, or $54.14 figuring 4 per cent compound interest on the investment.

It should be noted that in growing timber on the basis of a sustained yield, or a continuous production of about the same amount, there is a continuous flow of income every year or short period of years which makes it entirely incorrect to figure the cost on a compound interest basis. No attempt will be made to explain this further, except to add that the principle applies in a measure to small-sized detached operations of growing timber, such as may be carried on by farm owners. (Fig. 25.)

What does it cost to grow a crop of planted longleaf pine?

The cost of growing a crop of planted longleaf pine may be estimated in much the same manner as finding the cost of growing a crop naturally started. In this case, the item of cost of planting must be included, also the accruing interest charges over the period. Assuming the same land value, taxes, cost of protection, and yield of timber per acre in 40 years, as in the foregoing paragraphs, and

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FIGURE 25.—A farmer's pine lot, which supplies poles, firewood, and saw timber. Once a year the lot is raked and the straw used or sold in town. The land is bringing to the owner $5 to $10 an acre per year

including $5 for the planting of an acre, the calculation for 40 years at simple interest amounts to:

Interest on land value of $5 and cost of planting ($5) per acre, or a total of $10 for 40 years at 6 per cent	$24
Taxes and cost of protection, estimated at 20 cents per acre yearly for 20 years and 40 cents per year thereafter for the following 20 years	12
Total cost of growing an acre of timber	36
Cost of growing a thousand board feet of planted longleaf timber (assuming a total yield of 12,000 feet per acre in 40 years)	3

If it is desired to consider the cost of growing timber crops on the basis of compound interest, the following example may be helpful: With land, taxes, protection, and cost of planting all identical with those in the preceding question, the total cost during the growing period of 40 years at 4 per cent amounts to $65.86 per acre. With a return of 12,000 board feet of timber per acre (2,000 in thinnings and 10,000 in final yield), the average cost of growing a thousand feet is $5.49. The estimated average value of this timber at the time it is cut, in thinnings and in final harvest, is placed at $8 per thous-

and feet, leaving a fair profit above all items of cost. There is good ground, as stated on page 31, for omitting altogether a calculation on the basis of compound interest. After the first 15 years there will almost surely be periodic money return from the growing crop as well as an income from other timber ready for the market.

Does it pay to grow longleaf pine timber?

A number of lumber companies and private owners in various parts of the South are already definitely engaged in growing timber as a business. These people appear in part to be relying upon computations such as those given above, but largely upon the recognition that

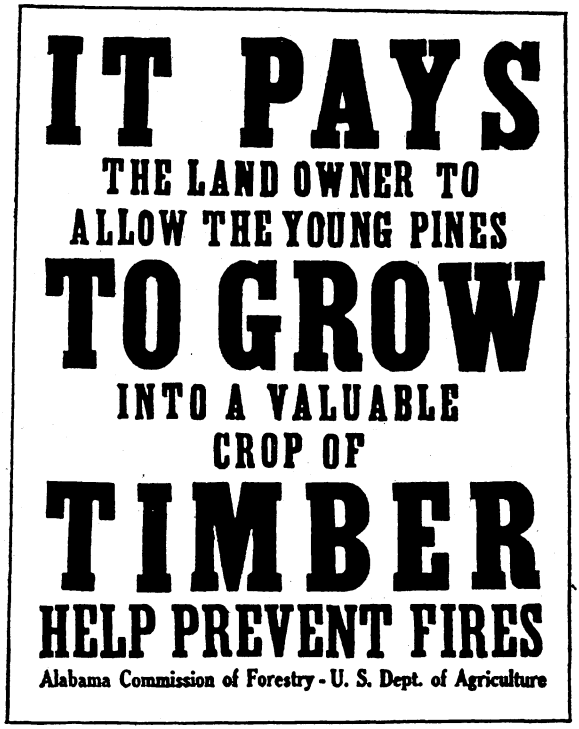

FIGURE 26:—Poster used by the Alabama Commission of Forestry in its cooperative fire-prevention work with the Forest Service, United States Department of Agriculture

timber is a necessity becoming increasingly scarce and upon the faith that whenever the present growing crops of timber are ready for the saw the prices will bear a suitable relation to the cost of production.

Once they are established the growing of pines as a crop, unlike the growing of ordinary farm crops, requires no labor other than for fire protection. The longleaf pine carries with it small risk of serious losses from any source. The safety of the investment follows from the unusual ability of longleaf pine to survive and recover from injury by fire, and its comparative immunity from serious insect or fungi pests.

The only other pine in the United States which produces both timber and turpentine is slash pine. The value of the turpentine

from second-growth trees of medium size may be considered as about twice that of the timber product. Although longleaf does not mature quite so early as some other kinds of pine, it is relatively a sure crop to grow. (Fig. 26.) Furthermore, it will grow on deep sandy land of a very low money value where practically no other tree can thrive. The stumps of longleaf pine trees are in demand for distillation by large chemical firms throughout the South. (Fig. 27.)

Second-growth pine on the stump is now (1938) worth in many parts of the South not less than $5 per thousand board feet. Fifteen years

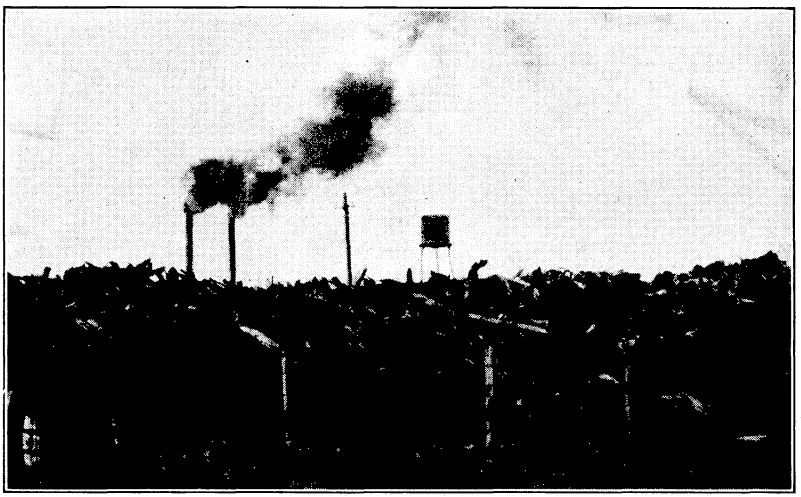

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FIGURE 27.—The stumps of longleaf pine trees, blown out of the ground by explosives, are sold by weight to chemical plants as "still" wood. The products of distillation include wood-turpentine, creosote, tar, pine oil, and acetic acid. The final commercial product is charcoal

ago, over most of the Southern States, it had practically no value. It seems fair to believe that during the next 10 to 20 years its present value will become at least double.

At the assumed value of $8 per thousand feet and a total production of 12,000 board feet per acre from longleaf pine at 40 years of age, a profit is apparent of $2.50 to $6 per thousand, depending upon widely varying conditions.

The large acreage of land unfit for cultivation, the long growing season, the relative cheapness of logging, the rising values of timber products of all kinds, and the relative nearness to large markets, are strong reasons for believing that timber can be profitably grown in the South.

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